AAoA Triple Pressure Sensor Series

High-Precision Airflow and Barometric Sensing for Accurate Angle of Attack Measurement

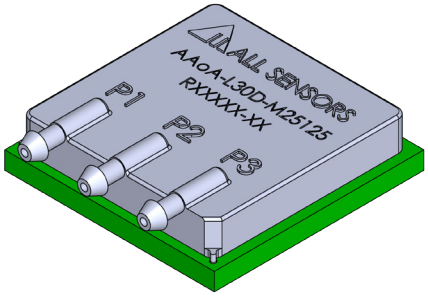


Table of Contents

Amphenol All Sensors AAoA Series is purpose-built to meet the demanding requirements of Angle of Attack (AoA) applications across a broad range of platforms, including military and civil aviation, guided and air-to-air missiles, commercial and defense UAVs, and emerging Urban Air Mobility (UAM) and swarming drone systems.

These compact sensors integrate high-accuracy differential and absolute pressure sensing with temperature measurement, enhanced by advanced temperature compensation and linearity correction. The result is precise, stable performance in mission-critical environments where reliability is essential.

Optimized for seamless integration into AoA systems, the AAoA Series features a compact, leadless, PCB-mountable design compatible with automated SMT assembly. Digital output options include both I^2C and SPI interfaces, while the low-profile side-port configuration requires only three connections—minimizing space, weight, and system complexity.

Contact us to learn how the AAoA Series can enhance your next Angle of Attack design.

Features

- Internal pressure manifolding to eliminate external pressure tubing connection between sensors
- Simultaneous Precision Measurement of two differential pressure and one absolute pressure sensor as well as temperature
- Wide Operating Temperature Range for Harsh Environments
- 24-bit High Resolution
- I²C or SPI Output Interfaces for all 3 sensors
- Compact and Lightweight Design
- Leadless Surface Mount Design compatible with SMT Automated Assembly
- Fully Customizable for OEM applications

Applications

- Military / Defense Aviation
- Civil Aviation
- Guided Missiles
- Air-to-air missiles
- Commercial, Defense, & Industrial Drones
- Swarming Drones
- Urban Air Mobility (UAM) systems

Standard Pressure Ranges

Device	Differential Operating Range [A]	Absolute Operating Range [A]	Proof Pressure		Burst Pressure	
			inH2O	kPa	inH2O	kPa
AAoA-L05D-M25125	± 5 inH20	250 mbarA - 1250 mbarA	270	67	415	103
AAoA-L10D-M25125	± 10 inH20	250 mbarA - 1250 mbarA	300	75	415	103
AAoA-L30D-M25125	± 30 inH20	250 mbarA - 1250 mbarA	350	87	415	103
AAoA-L60D-M25125	± 60 inH20	250 mbarA - 1250 mbarA	350	87	415	103
AAoA-L100D-M25125	± 100 inH20	250 mbarA - 1250 mbarA	350	87	415	103

Note A: Consult Factory for Additional Pressure Ranges

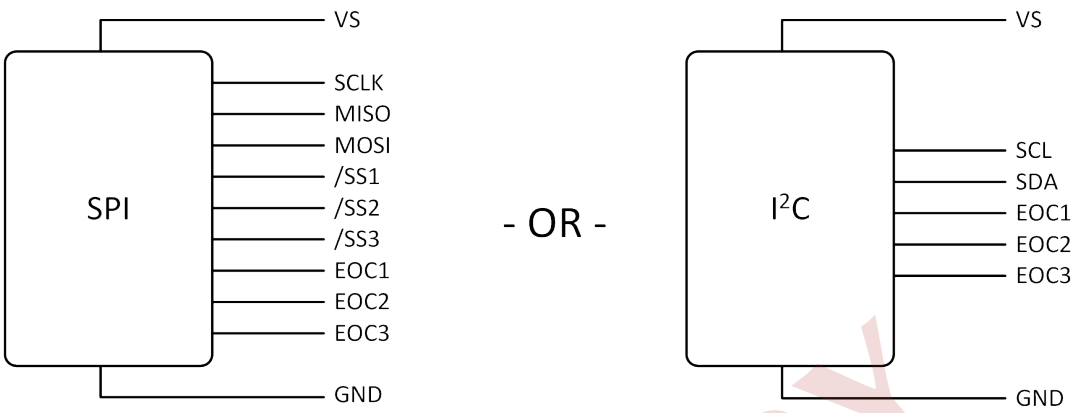
Pressure Sensor Maximum Ratings

Supply Voltage (Vs)	5.5 Vdc
Common Mode Pressure	50 psig
SMT Device Temperature	245°C

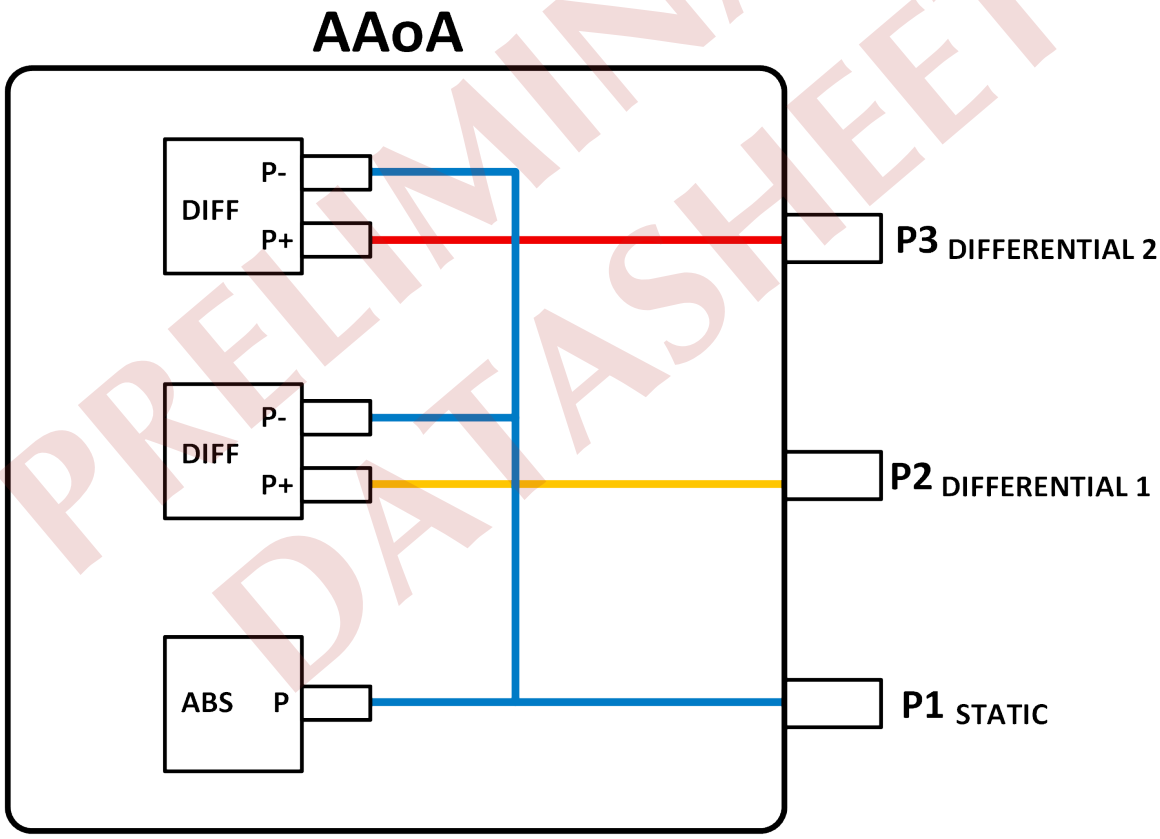
Environmental Specifications

Temperature Ranges	
Compensated:	-40°C to 85°C
Operating	-40°C to 85 °C
Storage	-40°C to 125 °C
Humidity Limits (non condensing)	0 to 95% RH

Electrical Block Diagram



Internal Pressure Connections



Performance Characteristics for AAOA Series High Accuracy Pressure Sensors

All Parameters are measured at 3.3V ±10% excitation and 25°C unless otherwise specified (Note 9). Differential Pressure measurements are with positive pressure applied to Ports P2 and P3. Absolute Pressure measurements refer to Port P1.

Parameter	Symbol	Min	Typ	Max	Units	Notes
Output Span						
Differential Channel	$Span_{dig}$	-	$\pm 0.4 * 2^{24}$	-	Dec Count	1
Absolute Channel	$Span_{dig}$	-	$0.8 * 2^{24}$	-	Dec Count	1
Offset Output @ Zero Diff./ Abs. Pressure						
Differential Channel	OS_{dig}	-	$0.5 * 2^{24}$	-	Dec Count	-
Absolute Channel	OS_{dig}	-	$0.1 * 2^{24}$	-	Dec Count	-
Error Summary						
L05D - Differential Channel						
Total Error Band [85C to -20C]	TEB_P	-	-	±0.25	%FSS	2, 6
Total Error Band [-20C to -40C]	TEB_P	-	-	±0.45	%FSS	2, 6
Accuracy	Acc_P	-	-	±0.10	%FSS	3, 6
L10D - Differential Channel						
Total Error Band [85C to -20C]	TEB_P	-	-	±0.20	%FSS	2, 6
Total Error Band [-20C to -40C]	TEB_P	-	-	±0.40	%FSS	2, 6
Accuracy	Acc_P	-	-	±0.10	%FSS	3, 6
L30D / L60D / L100D - Differential Channel						
Total Error Band [85C to -20C]	TEB_P	-	-	±0.15	%FSS	2, 6
Total Error Band [-20C to -40C]	TEB_P	-	-	±0.35	%FSS	2, 6
Accuracy	Acc_P	-	-	±0.10	%FSS	3, 6
Absolute Channel - All variants						
Total Error Band [85C to -20C]	TEB_P	-	-	±0.25	%FSS	2, 6
Total Error Band [-20C to -40C]	TEB_P	-	-	±0.45	%FSS	2, 6
Accuracy	Acc_P	-	-	±0.10	%FSS	3, 6
Offset Position Sensitivity (±1g)	Sen_{Pos}	-	±0.10	-	%FSS	-
Offset Long Term Drift (one year)	**LTOS**	-	±0.25	-	%FSS	-
Pressure Digital Resolution - No Missing Codes	Res_{Padc}	17.2	-	-	bit	-
Temperature Output						
Resolution (internal)	Res_{Tadc}	-	13	-	bit	-
Overall Accuracy	Acc_T	-	-	±2	°C	-

Electrical Specification:

Supply Voltage	V_S	2.7	3.3	3.6	Vdc	9
Supply Current Requirement						5, 7, 8
During Active State	ICC_{Active}	-	9.0	10.5	mA	-
During Idle State	ICC_{Idle}	-	4.5	18.0	µA	-
Power On Delay	t_{pwron}	-	-	2.5	ms	5
Memory Read Access Time	t_{rd}	-	100	2000	µs	4
Data Update Time	t_{du}		(see table below)			5, 7

Channel	Measurement Command										Units
	Single		Average2		Average4		Average8		Average16		
	Typ	Max	Typ	Max	Typ	Max	Typ	Max	Typ	Max	
Differential	2.0	2.2	3.8	4.2	7.4	8.2	14.6	16.2	29.0	32.1	ms

Specification Notes

NOTE 1: THE SPAN IS THE ALGEBRAIC DIFFERENCE BETWEEN FULL SCALE DECIMAL COUNTS AND THE OFFSET DECIMAL COUNTS. THE FULL SCALE PRESSURE IS THE MAXIMUM POSITIVE CALIBRATED PRESSURE.

NOTE 2: TOTAL ERROR BAND (TEB) IS THE COMBINATION OF ERRORS INCLUDING OFFSET, SPAN, LINEARITY, PRESSURE HYSTERESIS, TEMPERATURE EFFECT ON OFFSET, AND TEMPERATURE EFFECT ON SPAN.

NOTE 3: ACCURACY INCLUDES PRESSURE HYSTERESIS, REPEATABILITY AND BEST-FIT STRAIGHT LINE LINEARITY, EVALUATED AT 25C.

NOTE 4: DELAY BETWEEN END OF MEMORY READ REQUEST COMMUNICATION AND START OF MEMORY DATA READ COMMUNICATION.

NOTE 5: PARAMETER IS CHARACTERIZED AND NOT 100% TESTED.

NOTE 6: EVALUATED FOLLOWING CORRECTIONS DESCRIBED IN EXTENDED COMPENSATION SECTION.

NOTE 7: DATA UPDATE TIME IS EXCLUSIVE OF COMMUNICATIONS, FROM COMMAND RECEIVED TO END OF BUSY STATUS. THIS CAN BE OBSERVED AS EOC PIN LOW- STATE DURATION ON ABSOLUTE CHANNEL, OR AS DELAY TO EOC PULSE ON DIFFERENTIAL CHANNEL.

NOTE 8: AVERAGE CURRENT CAN BE ESTIMATED AS : ICC_{Idle} + (t_{DU} / READING INTERVAL) * ICCACTIVE). REFER TO FIGURE 2 FOR ACTIVE AND IDLE CONDITIONS OF THE SENSOR.

NOTE 9: THE SENSOR IS CALIBRATED WITH A 3.3V SUPPLY HOWEVER, AN INTERNAL REGULATOR ALLOWS A SUPPLY VOLTAGE OF 2.7V TO 5.5V TO BE USED WITHOUT AFFECTING THE OVERALL SPECIFICATIONS. THIS ALLOWS DIRECT OPERATION FROM A BATTERY SUPPLY.

I2C / SPI Electrical Parameters

Parameter	Symbol	Min	Typ	Max	Units	Notes
Input High Level	-	70	-	100	% of VS	5
Input Low Level	-	0	-	30	% of VS	5
Output Low Level (at 3mA sink)	-	-	-	10	% of VS	5
I2C Pull-Up Resistor	-	1000	-	-	Ω	5
I2C Load Capacitance on SDA, @ 400 kHz	C_{SDA}	-	-	200	pF	5
I2C Input Capacitance (each pin)	C_{I2C_IN}	-	-	10	pF	5
I2C Address:						
Absolute Channel P1	$Iadr_{Abs}$	-	37	-	dec	-
Differential Channel P2	$Iadr_{Diff1}$	-	38	-	dec	-
Differential Channel P3	$Iadr_{Diff2}$	-	39	-	dec	-

Pressure Output Transfer Function - Example

$$\textit{Differential Pressure} = 1.25 \times \left(\frac{P_{dig} - 2^{23}}{2^{24}}\right) \times \text{Cal Range}$$

Where:

P_{dig} is the sensor 24-bit output, following corrections applied by extended compensation

CalRange is 2x the calibrated differential pressure range: eg. for L05D is 10 inH20

$$\textit{Absolute Pressure} = 250 \text{ mbar} + 1.25 \times \left(\frac{P_{dig} - (0.1 \times 2^{24})}{2^{24}}\right) \times 1000 \text{ mbar}$$

Where:

P_{dig} is the sensor 24-bit output, following corrections applied by extended compensation

Temperature Output Transfer Function

$$\textit{Temperature (*C)} = \left(\frac{Tout_{dig} * 200}{2^{24}}\right) - 50$$

Where:

$Tout_{(dig)}$ The sensor 24-bit digital temperature output.

Extended Compensation Instructions

AAoA Series sensors have internal memory locations containing extended compensation coefficients. For optimal accuracy of pressure readings, system designers can use these values to apply an additional 3rd-order error-correction adjustment to data delivered from the sensor, as well as additional temperature compensation.

Theory of Extended Compensation:

The four linearity coefficients are programmed for each channel of the sensor at the factory as a 3rd order minimization solution to

(1) Error = Pref - (POut + f(POut)),

where

Pref is the true pressure applied;

POut is the sensor output;

f(POut) is a cubic correction function, Ax3+Bx2+Cx+D.

Then

(2) Pcorr = Pout + f(Pout) as the linearity-corrected pressure value.

For improved accuracy over temperature, residual temperature dependent errors are minimized by the term:

(3) TCadj = (1 - (Es * 2.5 * | 0.5 - Pcorr |)) * (T - Tref) * TC50

where:

TC50 = TC50H/TC50Scale for T > Tref

TC50 = TC50L/TC50Scale for T < Tref

and

TC50Scale = 100 * 100 * 167772.

This represents the possible range of temperature-dependent error, scaled to temperature counts.

Then

(4) Pcomp = Pcorr – Tcadj

for the final optimized pressure value. This is used in the Pressure Output Transfer Function on Page 5 to obtain pressure in appropriate units.

Additional Application Information

Assembly Recommendations:

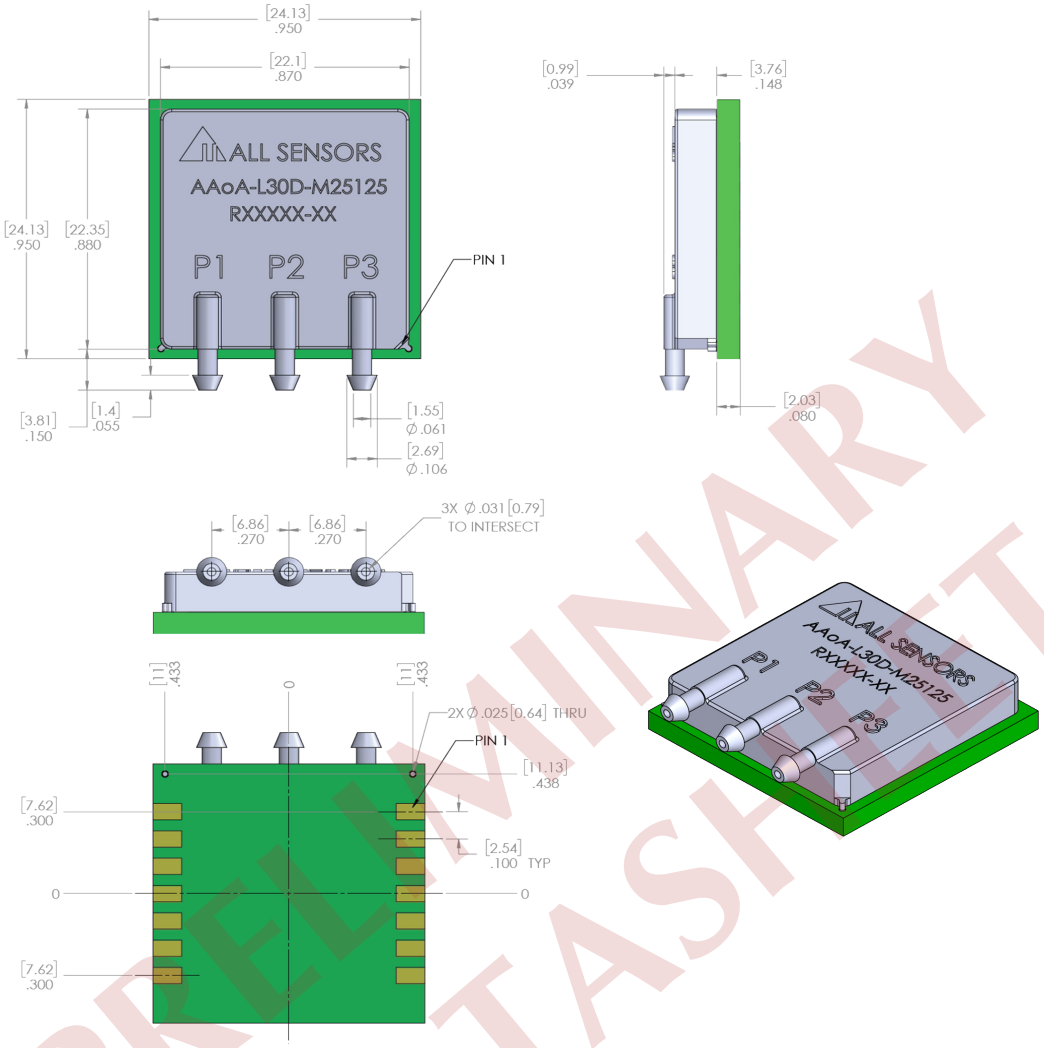
AAoA devices are non-hermetic and should be handled in accordance with IPC/JEDEC standard J-STD-020 classification MSL-4: SMT assembly or other high-temperature processing must be performed within 72 hours of opening factory-sealed packaging, in an environment of < 30C / 60% RH.

Beyond this interval, a bake process at 125C for 24h is required.

If a PCBA cleaning process is required, parts must not be immersed or subject to compressed air. If necessary, manual cleaning is recommended. No foreign matter of any kind may enter the pressure ports.

If secondary system calibration is to be performed, allow 48 hours for settling after SMT exposure.

Package Drawing [inches]



Pin	Symbol	Description
1	VS	Power Supply
2	SCL/SCLK	Clock for I2C or SPI
3	SDA/MOSI	Data I/O for I2C, Data Input for SPI
4	GND	Power Supply Ground
5	N/C	Not Connected
6	GND	Power Supply Ground
7	MISO	Data Output for SPI
8	GND	Power Supply Ground
9	/SS1	For SPI, Slave Select to enable Absolute Channel P1 output
10	EOC1	End of conversion for Absolute P1: 5usec positive pulse when reading complete
11	/SS2	For SPI, Slave Select to enable Differential Channel P2 output
12	EOC2	End of conversion for Differential P2: 5usec positive pulse when reading complete
13	/SS3	For SPI, Slave Select to enable Differential Channel P3 output
14	EOC3	End of conversion for Differential P3: 5usec positive pulse when reading complete

How to Order AAoA Series

For example, **AAoA-L30D-M25125-RR-N** defines an All Sensors AAoA Series pressure sensor with 30 inH2O differential pressure and 250 to 1250 mbar absolute pressure range, RR package (SMT with two barbed side ports), and no coating options.

AAoA - L30D - M25125 - RR - N

Product Series

AAoA	Differential and Absolute Combined Pressure sensors

Pressure Ranges Differential

L05D	± 5 inH2O
L10D	± 10 inH2O
L30D	± 30 inH2O
L60D	± 60 inH2O
L100D	± 100 inH2O

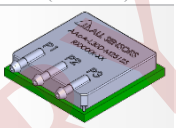
Pressure Ranges Absolute

M25125	250 to 1250 mbar

Package Selection

SMT (No Leads)

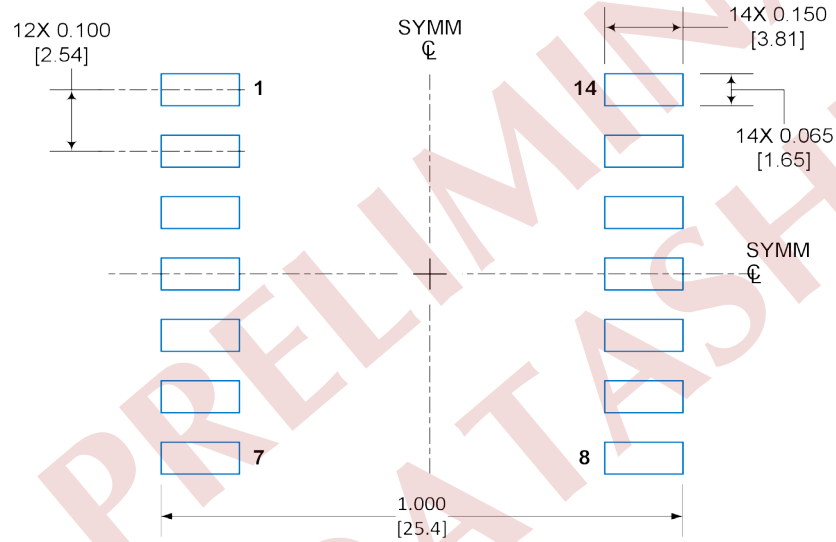
RR



Options

N	N/A Options

Pad Layout



Product Identification